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(54) SELF-CONTAINED MOBILE CLEANING UNIT

(72) Ruiter, Bernardus A.,
Canada

Granted to Cleanco Cleaning Equipment Limited,
Canada

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ABSTRACT OF THE DISCLOSURE

This invention relates to a self-contained mobile cleaning unit for pressure washing surfaces of various things such as carpets, buildings, vehicles, and the like. The invention is particularly intended for cleaning carpets of all types. The invention is directed to a self-contained mobile cleaning unit for pressure washing surfaces comprising: (a) a vehicle for transporting the self-contained mobile cleaning unit; (b) a power driven water pressure pump; (c) a power driven suction pump; (d) the water pressure pump (b) and the suction pump (c) having their respective power drive systems detachably connected to a liquid cooled engine driving the vehicle (a) and deriving their power from the engine; (e) a water holding means which is connected to the liquid cooling system of the vehicle engine and contains water which absorbs heat from the cooling liquid in the cooling system; (f) a cleaning means which operates in co-operation with the water pressure pump (b) and sprays water from the water holding means (e) against the surface to be cleaned; and (g) a vacuum means connected to the suction pump (c) and capable of drawing away water sprayed on the surface being cleaned by the cleaning means (f).

This invention relates to a self-contained mobile cleaning unit for pressure washing surfaces of various things such as carpets, buildings, vehicles, and the like. The invention is particularly intended for cleaning carpets of all types.

BACKGROUND OF THE INVENTION

Most cleaning done today under the name "steam cleaning" is actually cleaning performed with hot water under pressure. "Steam" cleaning is widely used today to clean various surfaces, but is particularly used to clean carpets. The equipment used for "steam" cleaning carpets must be portable. Many companies are engaged in this business and transport their "steam" cleaning equipment in trucks, vans, or the like. The basic performance components of the equipment are (1) a source of hot water (usually the hotter the water, the better the cleaning action), (2) a high pressure hot water pumping source, (3) a high vacuum drawing source to draw away the hot water after it has been used to clean the object being cleaned, and (4) a light weight portable hand held cleaning tool usually called a "wand".

The transportable cleaning equipment used today to perform the first three of the required functions described above is usually composed of (1) a hot water tank with the hot water heated by a propane heater, (2) a hot water pressure pump driven by a gasoline engine, and (3) a vacuum drawing pump that is driven by the same gasoline engine as that used to drive the hot water pressure pump. This system is cumbersome, space consuming, expensive, and has a large number of components. Moreover, maintenance

is troublesome because frequently the gasoline engine can be tempermental. Moreover, propane must be purchased to supply the propane heater.

SUMMARY OF THE INVENTION

The apparatus we have invented is compact, efficient, and unexpectedly obtains power and heat for all the components solely from the engine of the truck or van. The extra gasoline engine and the propane heater are not required. We have found that the self-contained apparatus we have invented delivers sufficient power for the hot water pump and suction equipment and all the hot water needed for cleaning carpets, or cleaning other surfaces, without the aid of auxiliary heaters or engines.

In a typical situation, when cleaning the carpets in a building, the truck transporting our self-contained cleaning unit remains outside the building and only a vacuum hose and a cleaning solution hose, which are connected to the special cleaning head (wand), are taken inside the building.

The water pressure pump and the suction pump, which are located inside the truck are driven by a special power take-off assembly which draws power from the engine of the vehicle. The heat required to heat the hot water is obtained solely from the coolant in the cooling system of the engine. The engine heat, which is normally wasted through the radiator cooling system, is utilized by passing the coolant through a heat exchanger which heats the hot water solution used for cleaning. This eliminates the need for the well-known separate hot water heating system, such as a propane burner, which is virtually standard equipment in conventional truck mounted cleaning systems.

Our cleaning unit deriving power from the vehicle engine easily delivers pressurized cleaning liquid at a pressure of 450 to 500 lbs/sq. inch. However, the unit is capable of generating pressures of up to 800 lbs/sq. inch. Cleaning liquid at such pressures when sprayed onto the carpet gives excellent agitation and deep cleaning action. The spent liquid is drawn away with a vacuum hose normally having a vacuum of 12 inch Hg. The suction pump to generate this vacuum is powered by the vehicle engine. However, the unit is capable of generating a vacuum of 20 inch Hg. A vacuum of this degree is capable of drawing relatively light objects away at a very high velocity and hence readily removes the dirt saturated spent liquid as well as any foreign matter or residue affixed to or held in or on the carpet or surface being cleaned.

We have unexpectedly found that the heat developed by the cooling system of the truck or van engine is sufficient to heat the cleaning liquid to a temperature of 200°F, and is capable of maintaining the cleaning liquid at a temperature between 170° and 190°F throughout even long cleaning jobs. When no cleaning is being done, the water quickly heats up again to about 200°F.

Besides being economical and practical, the unit we have invented is space saving because the equipment is 2 and 2 1/2 feet high, and requires only about 18 square feet of floor space in the truck or van, thereby leaving more than three quarters of the space in the van for other purposes.

The invention includes a self-contained mobile cleaning unit for pressure washing surfaces comprising:

(a) a vehicle for transporting the self-contained mobile cleaning unit;

(b) a power driven water pressure pump;

(c) a power driven suction pump;

(d) the water pressure pump (b) and the suction pump (c) having their respective power drive systems detachably connected to a liquid cooled engine driving the vehicle (a) and deriving their power from the engine;

(e) a water holding means which is connected to the liquid cooling system of the vehicle engine and contains water which absorbs heat from the cooling liquid in the cooling system;

(f) a cleaning means which operates in co-operation with the water pressure pump (b) and sprays water from the water holding means (e) against the surface to be cleaned; and

(g) a vacuum means connected to the suction pump (c) and capable of drawing away water sprayed on the surface being cleaned by the cleaning means (f).

The unit can include a system wherein the water pressure pump and the suction pump are connected to the vehicle engine by a power take-off assembly which on manual command engages with the engine of the vehicle while the engine is running and delivers power to the water pressure pump and the suction pump.

The unit can include a system wherein means are connected to the throttle of the vehicle engine so that when power is to be delivered to the water pressure

pump and the suction pump, the throttle of the vehicle engine is actuated whereby the vehicle engine runs at a higher predetermined speed. The water holding means can be a tank and the coolant solution from the liquid cooling system of the vehicle engine can be circulated by means of a coil positioned in the tank through water held in the tank whereby a transfer of heat from the coolant solution to the tank water takes place.

The tank can be equipped with a water inlet used for filling the tank with water, a water outlet which permits heated water to be withdrawn from the tank, and a safety pressure release valve. The heated water withdrawn from the tank can be blended with cold water in a hot water-cold water mixer thereby to provide water of a desired temperature. The heated water withdrawn from the tank can be blended with cleaning chemicals in a cleaning chemicals mixer.

The components making up the cleaning unit can be independently controlled by:

(h) a cold water intake connection which controls the rate and quantity of cold water admitted to the tank;

(i) a hot water temperature gauge which is connected to the tank and is capable of measuring the temperature of the hot water in the tank;

(j) a vacuum gauge which is connected to the suction pump and measures the degree of vacuum drawn by the suction pump;

(k) a cleaning chemicals flow control and indicator which determines the rate of flow of the cleaning chemical added to the heated water drawn from the tank;

(l) a hot and cold water mixer temperature control which regulates the temperature of the water blended in a water mixer; and

(m) a master on/off switch which determines when the unit can operate.

The water drawn away from the surface being cleaned can be returned by a suction hose connected to a waste water tank mounted in the transporting vehicle. The cleaning means for cleaning the surface can be a vacuum wand which contains within itself

(n) a hot water delivery means which thereby permits the hot water to be pressure sprayed against the surface being cleaned and

(o) a suction means which draws away spent water from the surface being cleaned.

The unit can be designed so that it can be operated only when the master on/off switch is "On", the transmission of the vehicle engine is in "Park" position, and the ignition of the vehicle engine is "On". The power take-off assembly can be connected to the vehicle engine by an electrically activatable electro-magnetic clutch.

DRAWINGS

In the drawings:

FIGURE 1 shows a side view of a vehicle fitted with the self-contained mobile cleaning unit;

FIGURE 2 is a top elevational view of the mobile self-contained cleaning unit;

FIGURE 3 is a cut away view of the heat exchanger;

FIGURE 4 is a side view of the drive shaft power take-off assembly; and

FIGURE 5A, B and C show three different views of the vacuum wand.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows a side view of the self-contained mobile cleaning unit mounted in a van 1.

Referring now in detail to the invention as a system and illustrated mainly in Figure 2, the power take-off assembly which provides the power for the cleaning unit (See Figure 4 for details) consists of a bearing support housing 31 which has a bearing 32 located at each end thereof. These two bearings 32 support a rotatable shaft 33 located inside the support housing. On one end of the support housing 31 (closest to the vehicle engine) there is located a mounting plate 34 which holds the coil of an electro-magnetic clutch. A pulley 37 is positioned at the other end of shaft 33. Located adjacent to the plate 34 is a free rotating pulley 35 which is connected to and driven by a V belt from the crank shaft of the engine of the vehicle. When energized by turning on the "on-off" switch 48, electricity flows through wire 36 which causes plate 34 and pulley 35 to be brought together. Pulley 35 is thereby mechanically connected to the shaft 33 which then rotates pully 37 on the other end of the shaft 33. The support housing 31 is held in place on a suitable support frame by a flexible mounting block 38 on each end. The power transmitted to pulley 37 is used to drive the cleaning equipment.

The hot water for the unit is provided by a unique hot water generating arrangement. The hot water is generated by a heat exchanger hot water tank 3 constructed of a 35 Gal. glass lined hot water tank 26 con-

containing approximately 60 feet of 1-inch copper pipe 30 formed into a coil (See Figure 3 for details). Pipe 30 is connected to and circulates hot engine coolant from the cooling system of the vehicle engine. The tank 26 containing pipe 30 is filled with water which enters the tank by means of an inlet 29. The heat of the engine coolant circulating through pipe 30 is transferred to the water in the tank 26. A hot water outlet 27 and safety pressure release valve 45 (for safety) are located on top of the tank 26. An adjustable valve 28 is provided in the engine coolant inlet line to control or stop the flow of the engine coolant through engine coolant supply line 10, when this is desirable to control the temperature of the water in the tank 26. This system has unexpectedly been found to be capable of heating water at a rate of 1.5 to 2 gallons of water per minute up to a temperature of 165°F to 175°F.

The cold water input connector 43 can be connected by means of a garden hose, or the like, to any cold water supply. The pressure and amount of cold water intake is controlled by a pressure indicator and regulator 42. The cold water is fed through line 23 into the cold water input 29 of the hot water tank 26 (See Figure 3). Cold water is also fed into the water temperature regulator and mixer 14.

The heat exchange tank 3 is maintained so that it is always full of water. The pressure of the cold water is applied to the intake 29, which thus pressurizes hot water outlet 27. The water in tank 3 is normally heated to between 170 and 200°F.

The various components of the cleaning apparatus as described are controlled by a number of controls mounted on instrument panel 25. These controls are (1) a cold water intake connection 43 containing a water return valve, (2) a cleaning solution output high pressure safety connector 44, (3) a hot water temperature gauge 46, (4) a vacuum gauge or elapse time indicator (not shown), (5) a cleaning chemicals flow control and indicator 40, (6) a hot and cold water mixer control dial, with automatic temperature control (not shown), and (7) a master on-off switch 48.

When hot water is required for cleaning purposes, hot water from tank 26 is fed into a water mixer valve 14 from one side. Cold water from line 23 to regulate the temperature of the water mixture is fed into the other side of the mixer valve 14. The streams of hot and cold water are blended together automatically by mixer valve 14 in accordance with a prescribed temperature as selected on the temperature dial 46 (on the instrument panel). It is necessary to be able to provide various water temperatures for various articles being cleaned. For example, some carpets will shrink if contacted with very hot water and thus relatively cool water must be provided. The blended hot water from the outlet of the mixer valve 14, regulated so that it is of the desired temperature, is carried to a cleaning chemicals mixer 13. Cleaning chemicals are added to the water to enhance the cleaning properties of the water. The cleaning chemicals are held in cleaning chemicals container 16. The container 16 is connected by a hose 24 to a cleaning chemicals flow indicator 40

which in turn is connected to mixer 13. The amount of cleaning chemicals added to the hot water by mixer 13 to form the cleaning solution is regulated by the setting of the control knob on the flow indicator 40 (mounted on the instrument panel). The control knob is adjusted by the operator, as desired. Usually the addition of cleaning chemicals in the range 1-100 cc/min will be sufficient for most cleaning jobs. Of course, in some situations it may be desired to only rinse an article and in this case no cleaning chemicals are added to the water.

When the operator wishes to use the cleaning unit, the engine of the vehicle is started in the normal way, and the gear shift lever is put in the "Park" position for safety. The unit is designed to operate only when the vehicle ignition is "On", the gear shift lever is in "Park", and the on/off switch 48 on the unit instrument panel is in the "On" position. When these three conditions are satisfied, the electrical circuit to the coil of the electro-magnetic clutch 6 is completed and power to drive the water pump and suction pump components of the cleaning system is available. When the electro-magnetic clutch 6 is energized, the power take-off drive shaft 4 rotates and drives vacuum pump 12 and water pressure pump 22 at the idling speed of the vehicle engine. The vacuum pump 12, by means of vacuum hose 15, draws a vacuum on waste water tank 19. Waste water tank 19 holds the dirty spent water that is returned from the cleaning operation through suction hose 20. A protection screen 21 prevents foreign matter from entering the vacuum pump 12. A vacuum relief valve 17

prevents the vacuum from building up to intolerably high pressures.

The vacuum drawn by the vacuum pump 12 is transmitted through external suction hose 20, together with the cleaning solution from pressure pump 22, and is controlled by an adjustable pressure unloader through pressure hose connector 44 and an external pressure hose extending to the double bend cleaning wand 50.

Actual cleaning of the surface, such as a carpet, is done by means of the vacuum wand 50 which has a head 52 that is about 3.75 inches high and therefore is capable of reaching under most furniture, desks, radiators, etc. The wand 50 has three nozzles 53 which have a combined flow of approximately 2 1/2 gal. of hot water per/min. and are controlled by a hand operated shut off valve 49 on the top of the wand 50 (See Figures 5a, 5b and 5c).

Placing the wand 50 on a carpet or surface to be cleaned restricts the air flow through the vacuum opening 54 and via external suction hose 20 virtually instantaneously and thereby forces a vacuum to be drawn by vacuum pump 12 on waste water tank 19. This vacuum is transmitted through conduit 15 and a vacuum line 9 which is connected to a vacuum diaphragm 7. When the vacuum has reached a prescribed subatmospheric pressure, it actuates diaphragm 7 via line 9 and this in turn actuates the throttle of the vehicle engine. The vacuum operating on the throttle causes the vehicle engine to speed up to a preset speed thereby permitting the vehicle engine to supply the power required for the cleaning operation. The engine runs at the preset speed throughout the cleaning operation. As soon as the cleaning

job has been completed, the vehicle engine returns to normal idle speed. Thus, with this system, the cleaning operator operating the double bend wand 50 has both a high vacuum and a high water velocity at his disposal thereby allowing him to efficiently clean the surface.

By manually depressing lever 51, (See Figure 5a) valve 49 opens, thereby forcing the blended cleaning solution through line 49A and the three nozzles 54 into the carpet at high pressure (approximately 450 lbs. per sq. in.). This pressure in association with the cleaning qualities of the cleaning solution serves efficiently to clean the carpet, or the surface which is being cleaned. Positioning the three nozzles 53 only a relatively short distance above the carpet insures that there is little temperature loss and superior cleaning action. The nozzles 53, as can be seen in Figure 5b are pointed to spray cleaning solution directly behind vacuum opening 54. Casual spray is restricted by spray shield 55. The cleaning solution, once it is circulated through the carpet, becomes saturated with dirt and foreign matter. It is then sucked away through vacuum opening 54 then through the vacuum line in the wand 50 and is returned to the waste water tank 19 by suction hose 20. The dirty water in the waste water tank 19 can be emptied by means of a valve 18 located at the bottom of the tank.

While particular embodiments of the present invention have been shown and described, it is apparent that various changes and modifications may be made, and it is therefore intended in the following claims to cover all such obvious modifications and changes as may fall within the true spirit and scope of this invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A self-contained mobile cleaning unit for pressure washing surfaces comprising:

(a) a vehicle for transporting the self-contained mobile cleaning unit;

(b) a power driven water pressure pump;

(c) a power driven suction pump;

(d) the water pressure pump (b) and the suction pump (c) having their respective power drive systems detachably connected to a liquid cooled engine driving the vehicle (a) and deriving their power from the engine;

(e) a water holding means which is connected to the liquid cooling system of the vehicle engine and contains water which absorbs heat from the cooling liquid in the cooling system;

(f) a cleaning means which operates in co-operation with the water pressure pump (b) and sprays water from the water holding means (e) against the surface to be cleaned; and

(g) a vacuum means connected to the suction pump (c) and capable of drawing away water sprayed on the surface being cleaned by the cleaning means (f).

2. The unit of claim 1 wherein the water pressure pump and the suction pump are connected to the vehicle engine by a power take-off assembly which on manual command

engages with the engine of the vehicle while the engine is running and delivers power to the water pressure pump and the suction pump.

3. The unit of claim 2 wherein means are connected to the throttle of the vehicle engine so that when power is to be delivered to the water pressure pump and the suction pump, the throttle of the vehicle engine is actuated whereby the vehicle engine runs at a higher predetermined speed.

4. The unit of claim 2 wherein the water holding means is a tank and the coolant solution from the liquid cooling system of the vehicle engine is circulated by means of a coil positioned in the tank through water held in the tank whereby a transfer of heat from the coolant solution to the tank water takes place.

5. The unit of claim 4 wherein the tank is equipped with a water inlet used for filling the tank with water, a water outlet which permits heated water to be withdrawn from the tank, and a safety pressure release valve.

6. The unit of claim 4 or 5 wherein the heated water withdrawn from the tank is blended with cold water in a hot water-cold water mixer thereby to provide water of a desired temperature.

7. The unit of claim 4 wherein the heated water withdrawn from the tank is blended with cleaning chemicals in a cleaning chemicals mixer.

8. The unit of claim 7 wherein the components (b), (c), (d), (e), (f) and (g) making up the cleaning unit are independently controlled by:

(h) a cold water intake connection which controls the rate and quantity of cold water admitted to the tank;

(i) a hot water temperature gauge which is connected to the tank and is capable of measuring the temperature of the hot water in the tank;

(j) a vacuum gauge which is connected to the suction pump and measures the degree of vacuum drawn by the suction pump;

(k) a cleaning chemicals flow control and indicator which determines the rate of flow of the cleaning chemical added to the heated water drawn from the tank;

(l) a hot and cold water mixer temperature control which regulates the temperature of the water blended in a water mixer; and

(m) a master on/off switch which determines when the unit can operate.

9. The unit of claim 8 wherein the water drawn away from the surface being cleaned is returned by a suction hose to a waste water tank mounted in the transporting vehicle.

10. The unit of claim 9 wherein the cleaning means for cleaning the surface is a vacuum wand which contains within itself (n) a hot water delivery means which thereby permits the hot water to be pressure sprayed against the

surface being cleaned and (o) a suction means which draws away spent water from the surface being cleaned.

11. The unit of claim 10 wherein the unit can be operated only when the master on/off switch is "On", the transmission of the vehicle engine is in "Park" position, and the ignition of the vehicle engine is "On".

12. The unit of claim 11 wherein the power take-off assembly is connected to the vehicle engine by an electrically activatable electro-magnetic clutch.

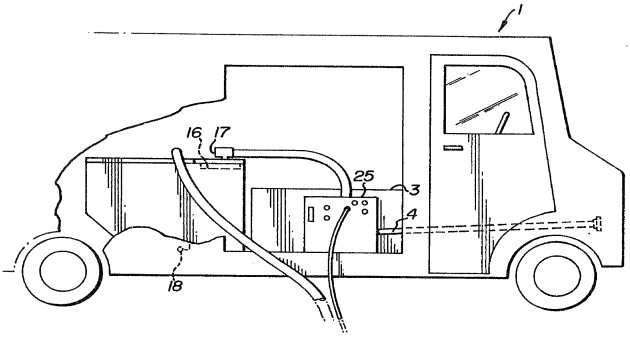

FIG. 1

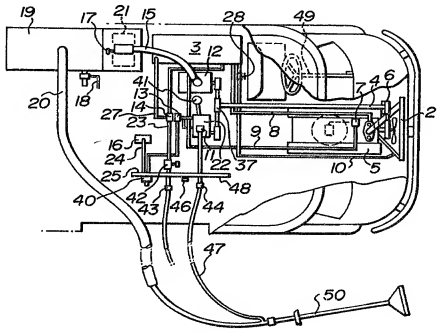

FIG. 2

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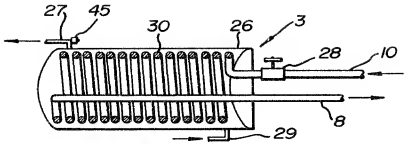

FIG. 3

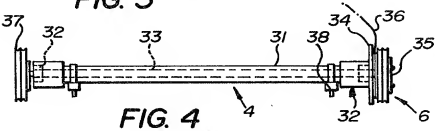

FIG. 4

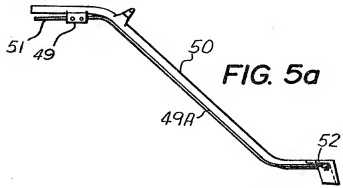

FIG. 5a

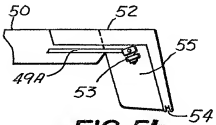

FIG. 5b

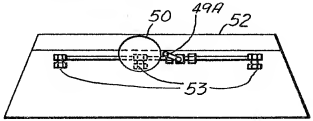

FIG. 5c

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